

Barrier Films and Thin Film Encapsulation

Lorenza Moro,
Samsung Cheil Industries

2014 DOE SSL R&D WORKSHOP
January 28-30, 2014

- Status
- Display vs. SSL Encapsulation
- Challenges

Barrier for Flexible OLED



Samsung Round



LG G-Flex

- The first two products with flexible high resolution AMOLED displays are on the market!
- The displays have the same quality as displays on glass.
- Two different encapsulation strategies: TFE and barrier on foil.

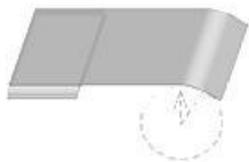
Display flexibility

Flexible Display Category



1 Plane

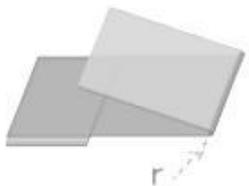
“Unbreakable”



2 Bendable



$\varnothing \geq 2\text{-cm}$



3 Foldable



4 Rollable



$\varnothing \leq 0.5\text{-cm}$

$\varnothing \approx 1\text{-cm}$

} X times

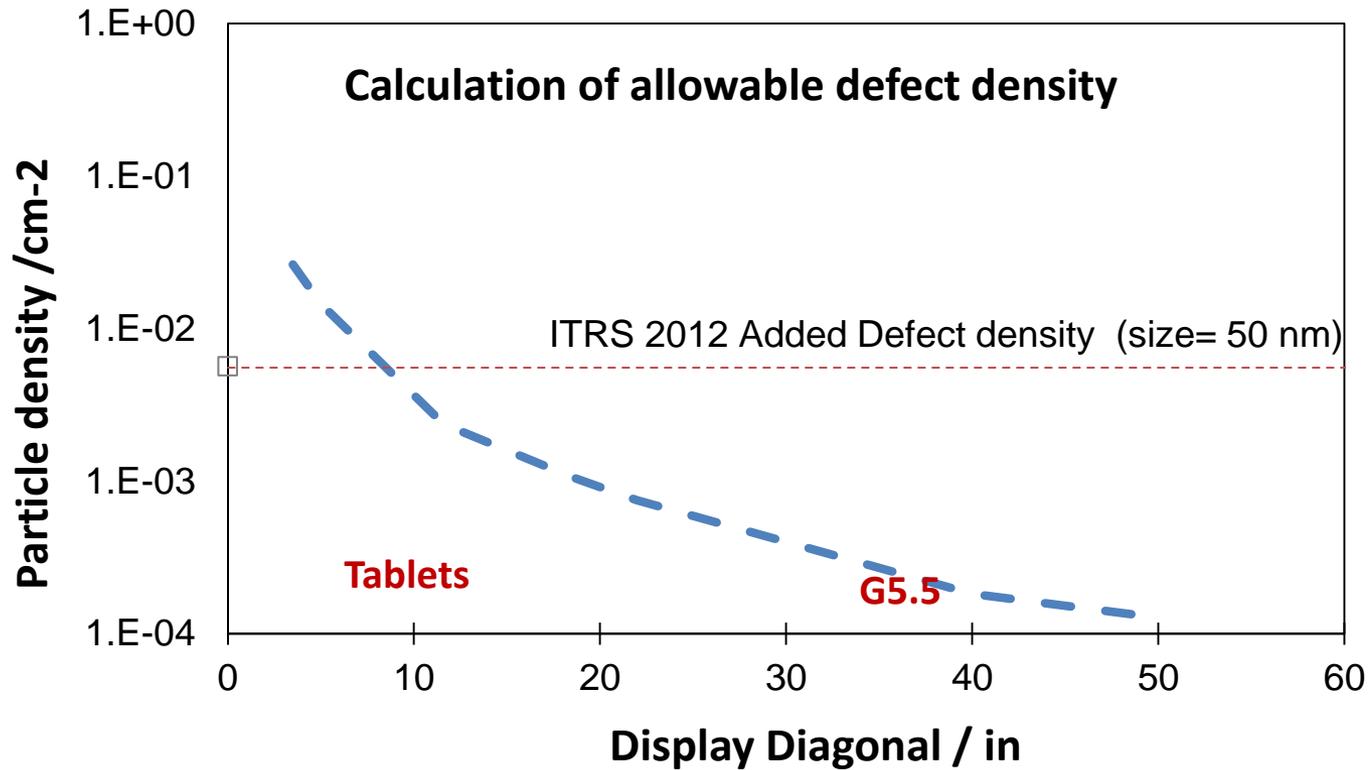
Samsung Create: Flexible Future Business Plan Contest RFP, August 2013

Display vs. SSL



Requirement	Display	SSL
Defects	Density ↓	Tolerance ↑
Light Management	Reflection /polarization	Extraction
Flexibility	High flexibility	Bendability
Edge width	width < 3mm	non critical
Cost	↑	↓

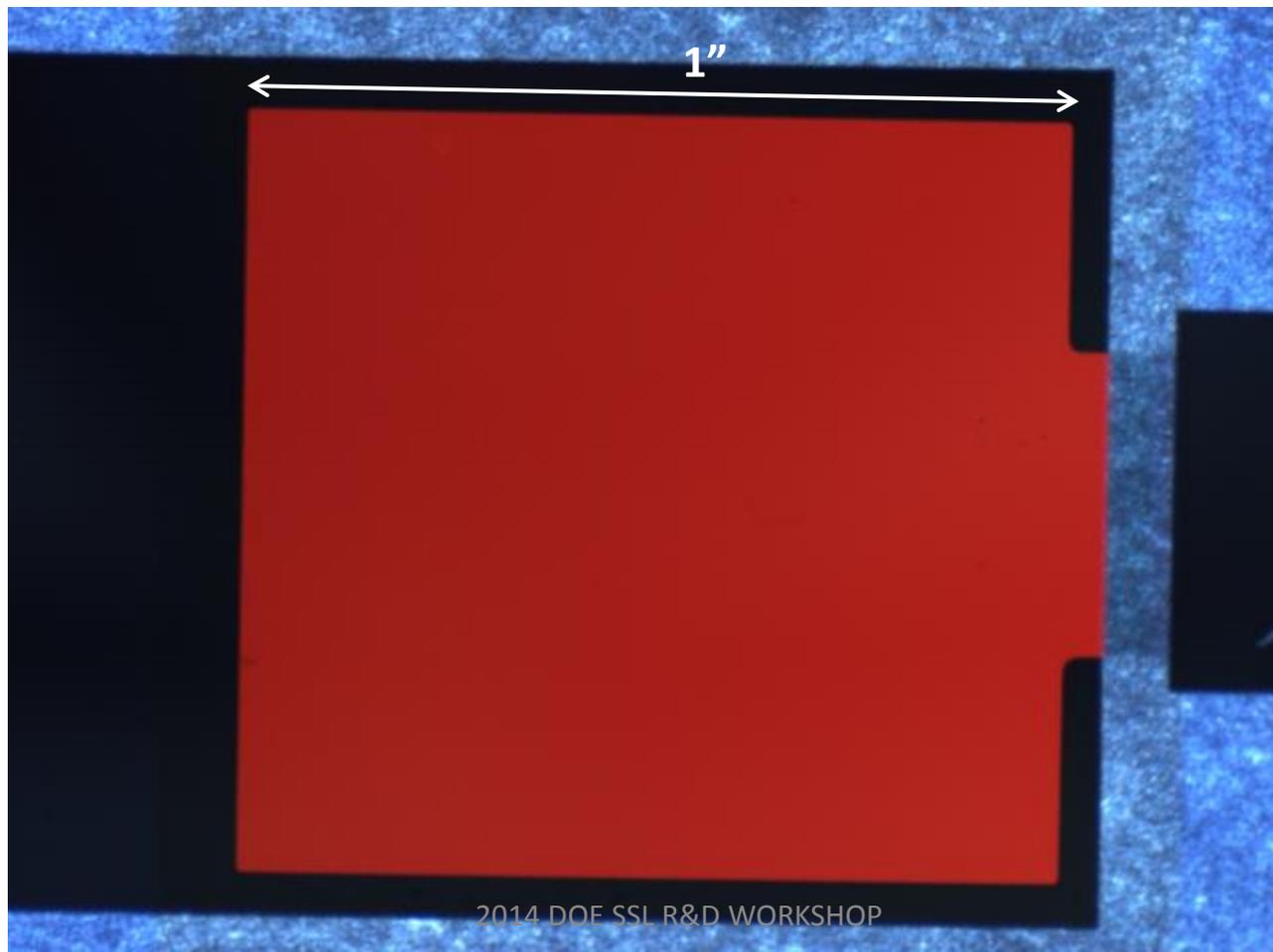
Defect density



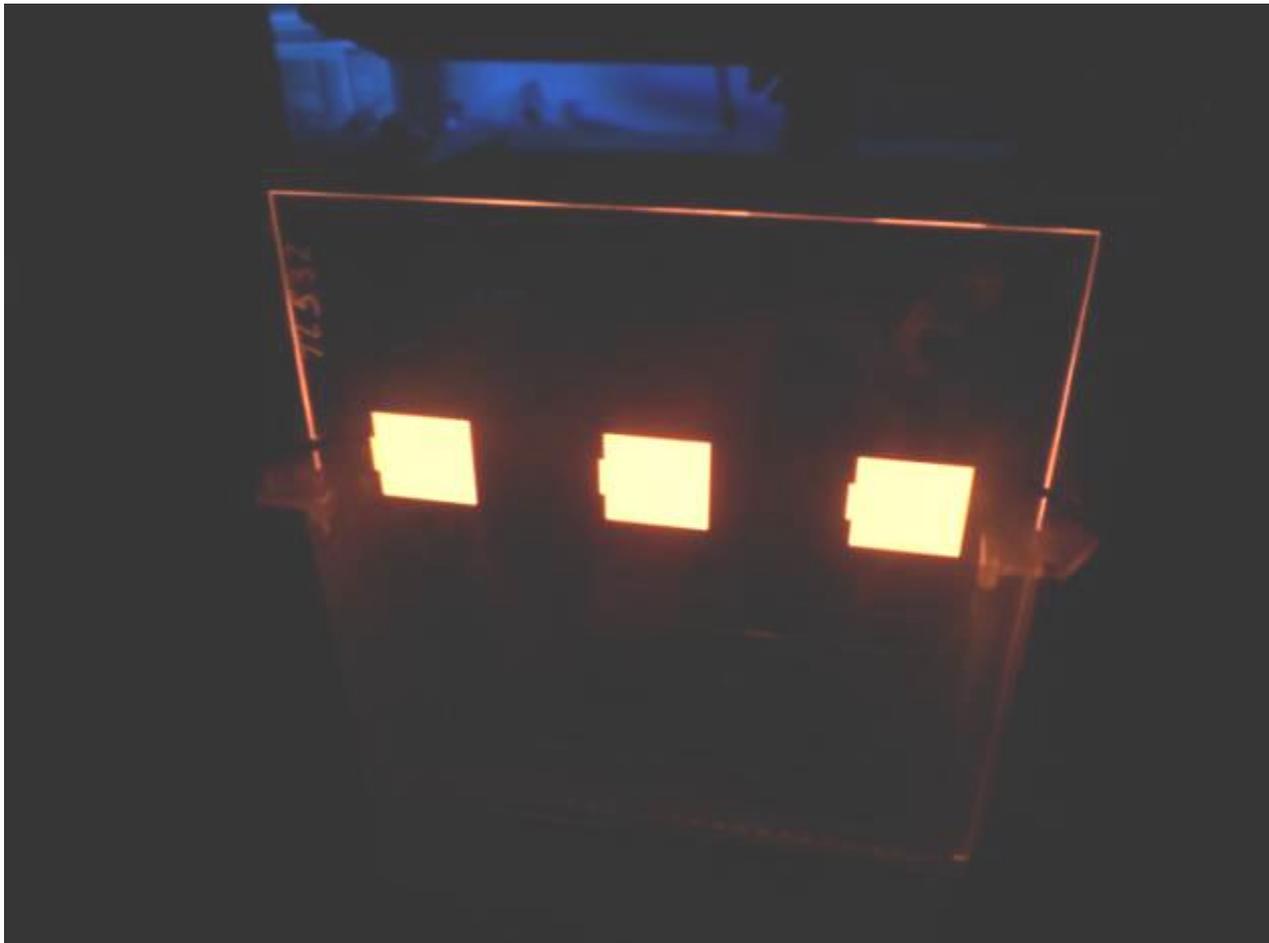
- Estimated particle density yielding one defect per display :
 - Acceptable particle densities for manufacturing are significantly below the line.

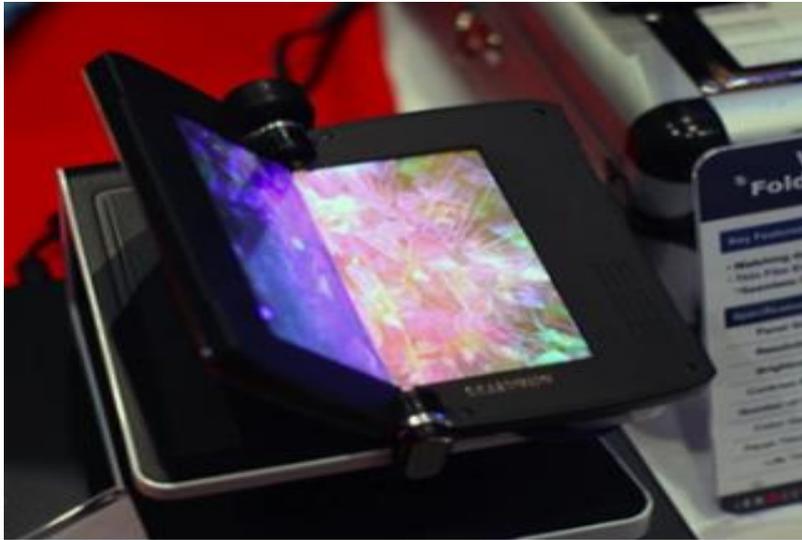
Defect tolerance

- Laminated OLED with 50-100 micron black spots (diameter) after 1,000h at 60C/90% RH.
- The defects are invisible at some distance.
- Note3 has a pixel density of 386 pixel per inch (65micron). At Samsung Analyst Day announced Samsung has announced that AMOLED smart-phone displays with 2560×1440 resolution will arrive sometime in 2014.



Transparent OLED. Structure is TFE Barrier-OLED - glass substrate.



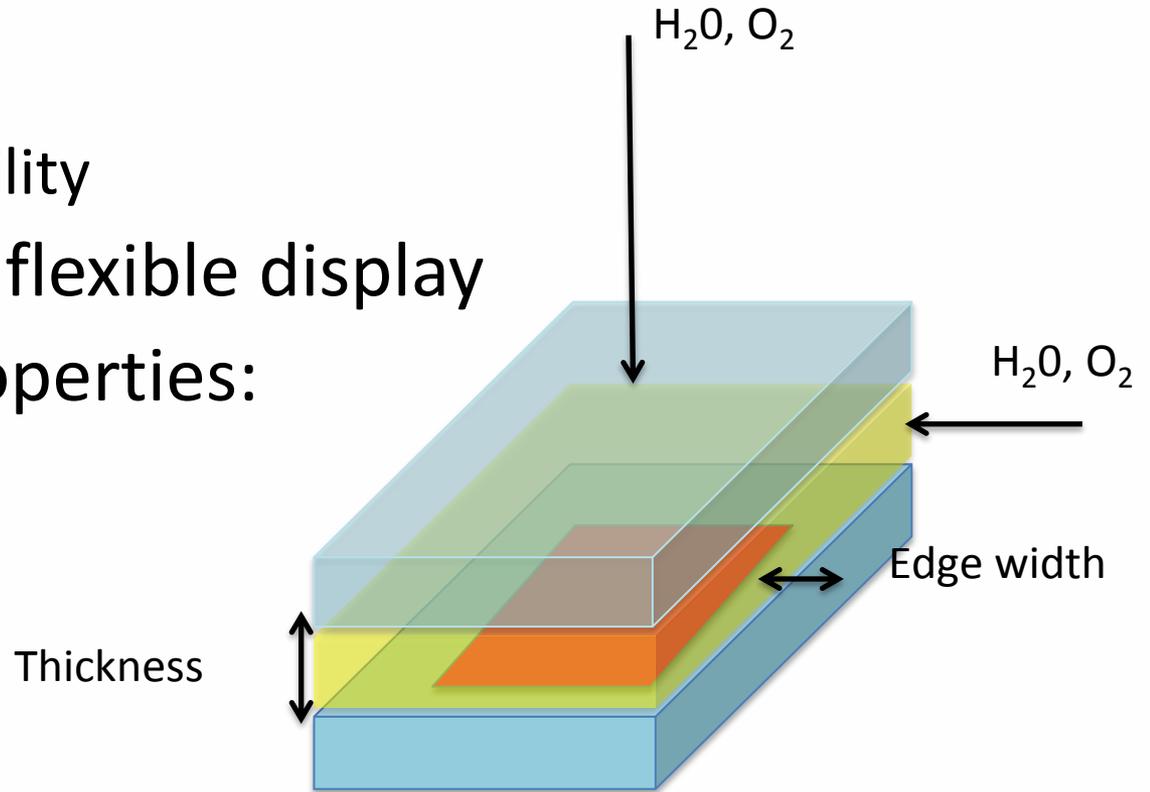


Foldable displays in 2015???



IMOLA (Intelligent light Management for OLED on foil Applications) EU Project , Press Release by TNO/Holst

- Adhesives
 - WVTR and bezel
 - Flexibility
 - WVTR vs. Flexibility
- Face sealant for flexible display
- Adhesive key properties:
 - Good adhesion
 - Transparency
 - Haze
 - Clarity
 - No yellowing



For full and widespread deployment of TFE and barrier on foil, marketing and technical challenges must be overcome.

- Some say that there is no strong evidence that a market large enough to justify investments in TFE and barrier on foil will develop in the short term.
- Several barrier technologies are viable, but the current challenges poorly addressed include:
 - Handling during fabrication;
 - Fabrication and inspection tools;
 - Light extraction functionality.